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Adverse effects of technical fouls in elite basketball performance

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ABSTRACT: This study examined the temporal effects of technical fouls on the performance of the fouling and opposing teams in elite basketball games. A sample of 80 technical fouls was collected from 65 international games. The fouls were charged either to players on court or to the bench players/coaching staff. Performance measures considered were the points scored (during 1, 3, and 5 ball possessions), fouls received, violations, and turnovers during 5 ball possessions before and after a technical foul was called. Data were also obtained on several contextual variables. The results showed that the opposing team scored slightly more points compared to the fouling team during 1 ball possession before and after a foul was charged to the coach/bench personnel ($F=5.934$; $p=0.019$; $ES=0.11$). The results also showed that both types of technical fouls are generally positive for the opposing team (mid-term effects) and for the fouling team only during the short-term performance (points scored after 1 ball possession). Furthermore, significant differences between teams were found when comparing the fouls received, with the opposing team receiving more fouls after both types of technical fouls ($F=5.364$; $p<0.001$; $ES=0.50$ and $F=26.350$; $p<0.001$; $ES=0.35$). However, the gender and contextual variables had no significant effect on any of the performance measures. The results highlight the positive short-term (1 ball possession) and the adverse mid-term (5 ball possessions) strategic effect of technical fouls for the fouling team, and call for coaches and practitioners to design specific training scenarios that involve tactics and strategies to avoid a negative performance immediately after the technical foul.

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INTRODUCTION

The context of competition in sports and the emotions involved frequently foster violence and forceful play [1]. The extent to which rule violations are judged as minor or major often reflects the degree of physical contact between the contesting players [2]. However, penalties are also used against the increasing number and frequency of instances of verbal aggression occurring on and around the sports ground, for example using language or gestures that may be considered offensive, assaulting or sneering at an opponent, or using trash talk that incites the audience. Early in the 1990s, there were already about 600 publications that are in some way relevant to this subject [3]. In the late 1990s, leading sports organizations such as the International Society of Sport Psychology (ISSP) had to take a clear position on this issue [4].

Fouls have been investigated mainly within the context of aggression [5]. Sports psychologists [6-7] have traditionally distinguished between "hostile" and "instrumental" aggression, depending on the intent and severity of behaviours [8]. In essence, hostile aggression is the result of a high arousal state [9], and often is a hallmark of the athlete experiencing a psychological performance crisis in competition [10]. Preliminary evidence for such an association was found in team handball [11] and basketball [12], mostly at the critical final stage of the game. This type of aggression mainly concerns unsportsmanlike fouls that are intended to hurt the other person, rather than being a means to achieve a goal [13]. However, our focus in the present study is more on those conscious and intentional actions that are often taken as part of defensive strategies during the game (e.g. interrupting a well-prepared action by the opponents to allow the team to correct mistakes in their defence). This type of instrumental aggression is generally motivated by the need to gain an advantage over the opponent, and thus lacks the spontaneous emotional component (no anger).

A unique category in this respect is the so-called "technical" fouls. These refer to rule infractions that do not involve physical contact, and are not always committed with an aggressive intent, such as delaying the game by intentionally touching the ball after it has passed through the basket or other kinds of violations (e.g. preventing the quick resumption of the game, pretending to have been fouled, or the defender illegally touching the ball during the last free-throw). Penalties awarded due to aggressive behaviour have been investigated in various sports (e.g. ice hockey, handball, tennis), but almost no published research exists on technical fouls in basketball. [14]. Thus, our understanding of the impact that these fouls may have on individual and team performance (e.g. within the context of competitive basketball) is quite limited [15]. It is our purpose to shed some more light on this unique and interesting topic.

According to FIBA official basketball rules [16] (Art. 36, 2018), the officials can charge a technical foul against players on court for the following actions or behaviours: i) interfering with a throw-in, ii) hanging on the ring, iii) distracting the opponent in the act of shooting (e.g. waving a hand, shouting loudly, or clapping hands near the shooter), iv) faking a foul, v) excessively swinging the elbows, and vi) any other displays of unsportsmanlike or flagrant behaviour during the interval of play. Within these behaviours, "negative verbalizations to officials" was found to be the most common expression of aggression observed in both hockey and basketball games [8].

Technical fouls are also charged to the coach/bench personnel when using non-legitimate physical contact, disrespectfully communicating with the officials, or while procedurally violating the rules. The most common technical foul charged to the coaching staff is for verbal complaints against the referee's decision while moving out of the coaching box or keeping close to the court.

From the perspective of performance analysis, several previous studies suggested that aggressive behaviour might help athletes (mostly in ice hockey; e.g. [17-18]), while a few others provided evidence that it might hurt some aspects of their performance (e.g. in tennis; see [19-20]). A more recent study by Zitek and Jordan [21] reported mixed conclusions about the relationship between displays of hostile aggression (as measured by the number of technical fouls a player received) and performance in NBA teams: while high levels of arousal hindered performance in tasks that required precision (e.g., making three-pointers), they positively affected players' success in tasks that required power and energy (e.g. making field goals, grabbing rebounds). It was thus suggested that true aggression (e.g. anger) might be adaptive for sports purposes, depending on the specific activity [22].

A somewhat different conclusion emerged from a study by Gómez, Ortega-Toro, and Furley [23]. The study reported on a tendency for elite basketball players to commit unsportsmanlike fouls while facing extremely stressful conditions during the game, often trying to stop the clock and having their own team recover from a negative performance momentum. Ironically, these (instrumental) fouls negatively affected the fouling team's subsequent scoring performance (-0.96 points), while providing a notable advantage (0.78 points) to the opponents.

Based on the literature on aggression (i.e. the definition of hostile aggression), we question Zitek and Jordan's [21] conclusions, as we suspect that technical fouls may express not necessarily hostile aggression, but rather a deliberate and functional behaviour [24], often committed as a result of tactical considerations. Thus, technical fouls might actually be instrumental in nature, in comparison to fouls that involve a hostile intent to hurt another. Our argument is relevant for fouls committed by players on court, but it is stronger when considering the bench players, and even more so, the coaching staff.

The present study used basketball games to examine the influence of technical fouls on performance at the team level. The study extended Zitek and Jordan's [21] work in the following three aspects: (i) the temporal effects of technical fouls; (ii) the analysis of technical fouls charged to the players on court and to the bench players and coaches; and (iii) the variations in the performance measures according to several contextual variables (score-line, quality of opposition, and time remaining). Therefore, based on the available literature, it was predicted that the context in which the foul was called would negatively influence the pre- and post-foul performance of the fouling team in all the studied measures compared with the opposing team.

MATERIALS AND METHODS

Sample

Data on 80 technical fouls (n=69 for men's and n=11 for women's teams) were collected during 65 games from men's (n=56 games) and women's (n=9 games) Olympic Games, and European and World Championships during the period of 2010-2013. Fouls were charged either to players on court (n=52) or to the coach/bench personnel (n=28). Statistics were obtained from play-by-play box-scores in the FIBA official open access web domain [25]. The mean final score difference between the competing teams when the games ended was 12.4±6.2 points, and the mean score difference when the technical fouls were charged to players on court or to the coach/bench personnel was 2.63±11.9 and 6.82±12.6 points, respectively.

In order to test for the validity of the raw data, a sub-sample of 12 technical fouls was randomly selected and coded by two independent qualified observers (having more than 10 years' experience in performance analysis in basketball). The obtained coefficients of agreement (Kappa) were 1.0 for all the variables analysed in each ball possession [26].

The local Institutional Review Board approved this study.

Variables

Possible short- and mid-term effects of technical fouls on the performance of the fouling and opposing teams were examined thorough the comparison between the number of points scored in each of the 1, 3, and 5 ball possessions before and after a technical foul was called [27]. The ball possession was considered as the temporal

parameter (i.e. length of possession), and the difference in the points scored after a technical foul was considered as the performance parameter (i.e. criticality measure) [15,23]. According to this approach, a short-term effect of the technical fouls was studied during 1 and 3 ball possessions, and a mid-term effect was examined during 5 ball possessions [23], while comparing the pre- and post-performances of both teams. The total number of 1 (1BP), 3 (3BP), and 5 ball possessions (5BP) was computed for both the fouling and the opposing team (n=80, n=152 and n=274, respectively for each team). Additionally, to control for other performance parameters before and after the technical fouls were called, the numbers of violations, turnovers and fouls received were also computed during 5BP.

Data were also obtained on the following contextual variables: (i) the score-line (i.e. the point difference between the competing teams when the technical foul was called), (ii) quality of opposition (i.e. final ranking difference between the two competing teams at the end of the championship), and (iii) minutes remaining for the game to end when the technical foul was called.

Statistical analysis

First, a descriptive analysis was computed, calculating the means and standard deviations for the points scored, fouls received, turnovers and violations. A repeated measures ANOVA was then applied for the analysis of the repeated measures of performance, before and after a foul was called (i.e., -1/1BP, -3/3BP and -5/5BP for points scored and -5/5BP for fouls received, violations and turnovers) considering the team as a factor (opposing vs. fouling team). The analysis was conducted separately for each condition of technical fouls, charged to players on court and coach/bench personnel fouls. The gender and contextual variables (i.e. score-line, quality of opposition, and time left for the game to end) were included as covariates in the model. The effect size (ES) estimations were calculated using partial eta squared (η_p^2) considering the following values: 0.01=small, 0.06=medium, and 0.13=large [28].

Finally, comparisons among pairs of conditions related to the teams (i.e., opposing vs. fouling team) and ball possessions (i.e., before and after a technical foul was called: -1/1BP, -3/3BP, and -5/5BP) were analysed using the Bonferroni post-hoc test. IBM SPSS Statistics for Windows, Version 21.0 (Armonk, NY, USA: IBM Corp.) was used for the analysis of the data. The significance level was set at $p<0.05$.

RESULTS

Descriptive data on technical fouls

Technical fouls were charged to players on court in the course of the following events: successful 2-point (19.2%) and 3-point (15.4%) field goals, unsuccessful 2-point (17.3%) and 3-point field goals (9.6%), foul actions (17.3%), violations (11.5%), and turn-

TABLE 1. Descriptive analysis for points scored, fouls received, violations and turnovers by condition and ball-possessions.

	Points scored according to ball-possessions											
	-1BP		1 BP		-3 BP		3 BP		-5 BP		5 BP	
Type of technical foul	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Player on court (n=52)												
Opposing team	1.15	1.18	1.19	0.91	3.13	1.70	2.56	1.51	4.88	2.32	4.06	2.09
Fouling team	1.08	1.23	1.10	1.19	2.71	1.89	2.81	1.92	4.24	2.54	4.67	2.72
Bench (n=28)												
Opposing team	1.33	1.11	1.59	0.80	3.35	1.79	3.58	1.47	5.08	2.48	5.54	2.55
Fouling team	0.59	1.05	1.22	1.15	2.92	2.10	2.65	2.15	4.84	3.04	4.20	2.74

	Fouls received (5BP)				Violations (5BP)				Turnovers (5BP)			
	Before		After		Before		After		Before		After	
Type of technical foul	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Player on court (n=52)												
Opposing team	0.53	0.50	1.43	0.85	0.24	0.43	0.16	0.37	0.24	0.43	0.45	0.50
Fouling team	0.73	0.45	0.73	0.45	0.19	0.40	0.13	0.34	0.21	0.41	0.35	0.48
Bench (n=28)												
Opposing team	1.03	0.19	1.52	0.83	0.17	0.38	0.28	0.45	0.21	0.41	0.17	0.38
Fouling team	0.61	0.50	0.79	0.42	0.29	0.46	0.25	0.44	0.36	0.49	0.39	0.50

Note: BP = ball possessions; M = mean; SD = standard deviation.

overs (9.6%). Technical fouls were also charged to the coach/bench personnel during successful 2-point (17.9%) and 3-point (7.1%) field goals, unsuccessful 2- (14.3%) and 3-point field goals (25.0%), foul actions (10.7%), violations (21.4%), and turnovers (3.6%).

Effects on points scored

Table 1 displays the descriptive information for points scored, fouls received, violations and turnovers in each of the conditions studied. The data showed that the fouling team's performance was worse than the opponents in points scored during 1BP, 3BP and 5BP (before and after) for fouls charged to the bench/coach personnel, and in 1BP (before and after) and in 3BP and 5BP before the fouls, for fouls charged to players on court. One interesting finding was that the fouling teams have short-term positive effects after fouls charged to the bench/coach personnel (an over two-fold increase in points scored: 0.59 before and 1.22 after 1BP) with an increase in violations by the opposing team and a decrease for the fouling team after the foul.

TABLE 2. Results of the repeated measures ANOVA for points scored, fouls received, violations and turnovers by condition and ball-possessions.

Points scored				**Fouls received, violations and turnovers**			
	F	p	ES		F	p	ES
Type of technical foul				Technical foul type			
Player on court (n=52)				Player on court (n=52)			
1BP	0.034	0.854	0.00	Fouls received 5BP	114.30	0.001†	0.53
1BP x Team	0.003	0.954	0.00	Fouls 5BP x Team	114.29	0.001†	0.53
Between teams	0.338	0.562	0.00	Between teams	5.364	0.001†	0.50
Bench (n=28)				Bench (n=28)			
1BP	2.829	0.099	0.06	Fouls received 5BP	12.530	0.001†	0.19
1BP x Team	1.478	0.230	0.01	Fouls 5BP x Team	2.651	0.109	0.05
Between teams	5.934	0.019*	0.11	Between teams	29.350	0.001†	0.35
Player on court (n=52)				Player on court (n=52)			
3BP	0.023	0.879	0.00	Violations 5BP	7.398	0.008†	0.07
3BP x Team	1.555	0.215	0.02	Violations 5BP x Team	0.172	0.679	0.00
Between teams	0.150	0.699	0.00	Between teams	0.206	0.651	0.00
Bench (n=28)				Bench (n=28)			
3BP x Team	0.304	0.584	0.01	Violations 5BP	0.984	0.326	0.02
3BP x Team	0.484	0.490	0.01	Violations 5BP x Team	4.153	0.046*	0.07
Between teams	0.244	0.078	0.07	Between teams	0.157	0.693	0.00
Player on court (n=52)				Player on court (n=52)			
5BP	0.199	0.657	0.00	Turnovers 5BP	21.730	0.001†	0.18
5BP x Team	3.108	0.729	0.04	Turnovers 5BP x Team	1.164	0.283	0.01
Between teams	0.004	0.953	0.00	Between teams	0.616	0.434	0.01
Bench (n=28)				Bench (n=28)			
5BP	0.001	0.977	0.00	Turnovers 5BP	0.001	0.980	0.00
5BP x Team	1.140	0.291	0.02	Turnovers 5BP x Team	2.001	0.103	0.04
Between teams	1.910	0.174	0.04	Between teams	2.559	0.115	0.04

Note: BP = ball-possessions; F = F-statistic; ES = effect size; * p<.05; † p<.01.

The results presented in Table 2 showed only one statistically significant effect for fouls charged to the coach/bench personnel between the opposing and fouling teams for 1BP ($F=5.934$; $p=0.019$; $ES=0.11$). The pairwise comparisons of teams' performances before and after the foul showed significant differences with better performances for the opposing teams ($p<0.05$). However, the other values were not significant and the covariates showed a non-significant effect in 1BP, 3BP and 5BP (all $p>0.05$).

Effects on fouls received, violations and turnovers

The descriptive results in Table 1 showed that the opposing teams received more fouls after fouls were charged to the other team, either to players on court or to the coach/bench personnel. However, the analysis of violations and turnovers revealed a mixed effect depending on the type of foul and team. While violations by both teams decreased after fouls charged to players on court, an increase in violations by the opposing team (and a decrease for the fouling team) was observed after fouls charged to the coach/bench personnel. In addition, turnovers largely increased in both teams after fouls charged to players on court, and decreased in the opposing teams after fouls charged to the coach/bench personnel.

The results for fouls received (see Table 2) showed significant effects for the repeated measures (before and after the foul) and between teams' performances, for fouls charged to players on court ($F=114.30$; $p<0.001$; $ES=0.53$; and $F=5.364$; $p<0.001$; $ES=0.50$, respectively) and for coach/bench personnel fouls ($F=12.530$; $p<0.001$; $ES=0.19$; and $F=29.350$; $p<0.001$; $ES=0.35$, respectively). However, a significant effect was found for the interaction between repeated measures and team ($F=114.29$; $p<0.001$; $ES=0.53$; large effect) only for fouls charged to players on court.

The pairwise comparisons between the repeated measures of performance for fouls received before and after the fouls showed significant differences for the opposing teams (better performance after the foul) for fouls charged to players on court and for coach/bench personnel fouls, and a minor increase in performance after the foul for the fouling teams ($p<0.05$). The comparisons between teams (fouling vs. opposing) showed significant differences after fouls charged to players on court, and before and after fouls charged to the coach/bench staff, reflecting a better performance for the fouling teams ($p<0.05$).

The results for violations (see Table 2) showed significant effects for the repeated measures (before and after the foul) for fouls charged to players on court ($F=7.398$; $p=0.008$; $ES=0.07$) and for the interaction between the repeated measures of performance and teams ($F=4.153$; $p=0.046$; $ES=0.07$). The pairwise comparisons showed significant differences before and after the foul for the opposing and fouling team, with a lower number of violations for both teams after the fouls ($p<0.05$).

Finally, the results for turnovers (see Table 2) showed a significant effect for the repeated measures of performance only for fouls charged to players on court ($F=21.730$; $p<0.001$; $ES=0.18$). The pairwise comparisons showed significant differences for the fouling team, with an increase in the number of turnovers after fouls charged to players on court ($p<0.05$). Gender and contextual variables (covariates) did not show statistically significant effects ($p>0.05$) in the analysis for fouls received, violations and turnovers ($p>0.05$).

DISCUSSION

The present study extended Zitek and Jordan's [21] work mainly through the analysis of temporal variations in performance due to technical fouls committed either by players on court or the bench personnel and coaches. The results showed that both types of technical fouls are generally positive for the opposing team (mid-term effects, 5BP) and for the fouling team only during short-term effect (1BP). More specifically, for technical fouls charged to players on court, we found a negative effect on the performance of the fouling team in terms of the number of fouls received and turnovers, when comparing pre-and-post fouls and between-team performances. These results point to the expected mid-term adverse effect (-5/5BP) of this type of technical fouls. The data also showed that for fouls charged to the coach/bench personnel, the unfavourable trend for the fouling team was stopped (0.59 to 1.22 points scored for -1BP/1BP). It might be that coaches seeing the ineffective play of their teams consciously force a foul to "rock the boat" (and probably also affect the referees' criteria), with the aim of improving the playing performance of their team using a short-term effect. In addition, the fouling team performed in the same way in terms of fouls received before and after a technical foul was called, but the opponents increased from 0.53 to 1.45 fouls when the foul was charged to the players on court. The findings of the current investigation are consistent with previous research [29-30], which indicated that basketball teams who were performing well before an adverse situation (e.g. a turnover, a missed field goal or free throw, or a shooting foul) generally responded better to that adversity than teams who were performing poorly.

The scoring trends in basketball games are important for the coaching staff's control of the competition [31]. Therefore, negative patterns in the performance of players on court might foster high levels of frustration and anxiety, which would then lead the coach/bench personnel to behave aggressively in an attempt to stop the positive momentum of the opposing team (and thereby the negative momentum of the fouling team). Ironically, this attitude is more likely to force a technical foul for the team that is behind [32]. For example, referees might charge a technical foul to the coaching staff standing in the coaching box (according to the game regulations, only one person is allowed to be standing in the box), while protesting against the referee's decision [33]. Coaches often try to control or stop the negative momentum also by having substitutions or calling timeouts. Previous research has shown that calling a timeout is generally an effective intervention for decreasing an opponent's scoring behaviour (e.g. 3-point field goals, 1-point foul shots). However,

the degree of reinforcement for the target team might be poor following a timeout (e.g. points scored, steals or blocked shots), which consequently creates negative individual responses to the mistakes or bad performance [30].

Sometimes coaches use technical fouls as a motivational resource, deliberately trying to force a technical foul in order to change the referee's criteria, and thus motivate their team [33]. Along these lines, our analysis demonstrates a slightly increased number of fouls received by the fouling teams (0.61 before and 0.79 after) based on this line of strategic thinking, but with a greater increase of fouls received by the opposing team (1.03 before and 1.52 after). This might reflect an enhanced crisis of vulnerability of players in response to both on-court and off-court technical fouls, which is expressed in the increased rate of fouls committed [10,12]. It might also reflect a tendency among referees to rigorously enforce the game regulations with regard to the fouling team. In general, the referees' decision whether to call a foul or not is influenced by different internal and external conditions [34], and in this case, all fouls – or at least most of them – are called, and not just the clearest ones.

One interesting finding of the current study is the short- and mid-term effect of technical fouls. From a positive/negative momentum approach, these results could be explained by the immediate positive rate of reinforcement that the player or coach might experience following the foul, pushing them to react aggressively or vigorously protest against the referee's decision. However, the mid-term effect is likely to be avoided by the coach using some resources that limit the impact of the technical foul, such as replacing the fouling player, calling a timeout or changing the current strategy [30].

The results of the current investigation should be of substantial interest to coaches and players. While the previously reported findings by Zitek and Jordan [21] showed that being overly aggressive to the point of receiving a technical foul could have positive results (e.g., earning points), our data suggest that being overly aggressive generally is disadvantageous for the fouling team from a mid-term performance (5BP) point of view. Conversely, this effect was the opposite from a short-term performance standpoint when fouling teams scored more points (19.5%) after the fouls charged to the coach/bench personnel. From a sports psychologist's perspective, such over-aggressiveness might express the fact that players are being distracted and more vulnerable to crisis, and thereby losing focus and concentration on task fulfilment [10]. The use of group- and individually tailored measures of mental preparation is strongly recommended to cope with these difficulties and re-focus the players on task performance [35].

One intriguing finding from the current analysis is the non-significant effect of the contextual variables on performance. In particular, it is surprising that the score-line was not an influential factor given that we rarely see winning teams receive technical fouls in games. One possible explanation for the inconsistency could be related to the fact that technical fouls are highly associated with actions taken by individual players and coaches under specific circumstances during the game, due to internal psychological processes, as suggested by Morgulev et al. [34]. In particular, sometimes players react against their own team's interests, due to poorer decision-making processes under biased or self-biased conditions. Furthermore, recent research [36] has found that the high level of competitiveness between counterparts masked the impact of some context-related factors, due to the performance similarities between the competing teams.

Finally, the current study has some limitations that should be taken into account. Despite the evidence provided for the short- and mid-term effects of technical fouls on the objective measures of performance of the fouling team, it would be interesting for future research to explore the coaches', players' and referees' subjective perspective as well. In particular, the influence of the psychological, emotional and cognitive factors that lead players and coaches to commit technical fouls have to be addressed using qualitative methods. Furthermore, research should control for gender effects of aggression due to the limited number of technical fouls analysed in the current study and the non-significant effect of this variable. Lastly, the 2018 FIBA regulations [16] modified the technical fouls rule, as "one free throw shall be awarded. After the free throw, the game shall be resumed by the team which had control of the ball or was entitled to the ball from the point when the technical foul was called". This rule modification is worthy of further investigation in terms of temporal and teams' performances due to the fact that the current rule avoids the double penalty to the fouling team (free throw and ball possession to the opponent's team), ensuring balanced criteria for both teams, fouling and opposing teams. In fact, more research is needed to identify the impact of the rule changes (i.e. the aspects of ball possession) and the reasons to modify the regulations.

CONCLUSIONS

To summarise, significant differences in the performance of the fouling and opposing teams were identified before and after each type of technical foul. Thus, it is advisable for the coaching staff to be aware of these consequences and practice short- (1BP) and mid-term (5BP) competition scenarios in which the players have to control for fouls committed and turnovers in both technical fouls. The results also highlight the importance of the immediate ball possession (1BP) after the technical foul charged to the coach/bench personnel, where the opposing team scores more points than the fouling team. However, the short-term effect (1BP) in the form of points scored after a technical foul charged to the coach/bench personnel showed that fouling teams stopped their unfavourable trend. Hence, it is worth considering preparing training sessions that simulate both conditions (on-court and off-court technical fouls) using the role of the fouling and opposing team. Lastly, from a psychological point of view, this study suggests that coaches and players have to be prepared to reduce the impact of technical fouls on their immediate performance (1BP, 3BP, and 5BP), applying psychological interventions before and during competitions [34].

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